AQUATIC CONSERVATION STRATEGY (ACS)

Note: This section includes information and discussions from FEMAT(1993) in order to present the source of concepts, the logic track, and administrative record behind the standards and guidelines in subsequent decision documents. The FEMAT document is an assessment and is not decision document. The decision documents are the result of NEPA analyses. As a result of NEPA analysis, many concepts were brought forward into the decision documents from FEMAT, while others were refined. While most of FEMAT's recommendation were incorporated into the standards and guidelines, some were modified and a few dropped.

Introduction: The Aquatic Conservation Strategy, ACS Objectives and Implementation

The components of the Aquatic Conservation Strategy, as introduced the FEMAT document are:

- A network of 162 Key Watersheds. These Key watersheds provide refuge areas critical for maintenance and recovery of at-risk stock of anadromous and resident fish[1].
- Riparian Reserves where riparian dependent resources receive primary emphasis and where special standards and guidelines apply.
- Watershed Analysis would be used to evaluate geomorphic and ecological processes operating in specific watersheds. The watershed analysis should enable watershed planning supportive of ACS objectives. Watershed analysis provides a basis for monitoring and restoration programs, and is the foundation for delineating the Riparian Reserves.
- Watershed restoration is an integral part of a program to aid recovery fish habitat, riparian habitat and water quality. "The most important elements of a restoration program are (1) to control and prevent road-related runoff and sediment production, (2) to improve the condition of riparian vegetation, and (3) to improve habitat structure in stream channels."

These components are designed to work together to maintain and restore the productivity of and resilience of riparian and aquatic ecosystems (FEMAT 1993 pg II-37 to II-40; V-32).

<u>The Aquatic Conservation Strategy Objectives:</u>

The Aquatic Conservation Strategy is designed to meet the following objectives:

1. *Maintain and restore the distribution, diversity, and complexity of watershed and landscape-scale features to ensure protection of the aquatic systems to which species, populations, and communities are uniquely adapted.*

2. *Maintain and restore spatial and temporal connectivity within and between watersheds. Lateral, longitudinal, and drainage network connections include floodplains, wetlands, upslope areas, headwater tributaries, and intact refugia. These lineages must provide chemically and physically unobstructed routes to areas critical for fulfilling life history requirements of aquatic and riparian-dependent species.*

3. *Maintain and restore the physical integrity of the aquatic system, including shorelines, banks, and bottom configurations.*

4. *Maintain and restore water quality necessary to support healthy riparian, aquatic, and wetland ecosystems. Water quality must remain in the range that maintains the biological, physical, and chemical integrity of the system and benefits survival, growth, reproduction, and migration of individuals composing aquatic and riparian communities.*

5. *Maintain and restore the sediment regime under which an aquatic ecosystem evolved. Elements of the sediment regime include the timing, volume, rate, and character of sediment input, storage, and transport.*

6. *Maintain and restore instream flows sufficient to create and sustain riparian, aquatic, and wetland habitats and to*

[1] In addition, no new roads would be built in inventoried roadless areas inside Key Watersheds. This affects National Forest lands only. The roadless area component was listed as a separate component used in developing options to be analyzed, but was included as part of the Key Watershed component in the description of ACS in chapter V of FEMAT.

retain patterns of sediment, nutrient, and wood routing (i.e., movement of woody debris through the aquatic system). The timing, magnitude, duration, and spatial distribution of peak, high, and low flows must be protected.

7. *Maintain and restore the timing, variability, and duration of floodplain inundation and the water table elevation in meadows and wetlands.*

8. *Maintain and restore the species composition and structural diversity of plant communities in riparian zones and wetlands to provide adequate summer and winter thermal regulation, nutrient filtering, appropriate rates of surface erosion, bank erosion, and channel migration and to supply amounts and distributions of coarse woody debris sufficient to sustain physical complexity and stability.*

9. *Maintain and restore habitat to support well-distributed populations of native plant, invertebrate, and vertebrate riparian-dependent species.*

<u>Discussion on Attainment of ACS Objectives:</u> All ACS Objectives begin with the phrase "maintain and restore." The "maintain" aspect of the objectives is primarily attained through the Riparian Reserves and the Key Watersheds components. The Late-Successional Reserve also provides additional protection at the landscape scale (USDA; USDI 1994b) along with other reserves, and congressional and administrative withdraws. The "restore" aspect of the objectives is attained through watershed analysis, which identifies restoration needs, and by the watershed restoration component.

Under the Forest Plan, the first Aquatic Conservation Strategy of maintaining and restoring, coarse scale distribution, diversity, and complexity of watershed and landscape scale features are provided for by an array of land use allocations. Watershed and landscape features associated with late-successional and old-growth forests are provided by the Late-Successional Reserves and Riparian Reserves. Watershed and landscape features associated with early and mid-successional forests are provided by Matrix lands. Management direction provides for retaining legacy structures/ attributes on the Matrix lands like coarse woody debris, snags and wildlife trees, and by that provide features found in unmanaged early and mid-successional landscapes. These legacy structures fulfill habitat requirements for some early and mid-successional associated wildlife species and make the early and mid-successional forest more hospitable and permeable for late-successional associated species (Hicks *et al.* 1999).

The second ACS objective to maintain and restore spatial and temporal connectivity is attained, in part, by including the following inside the Riparian Reserve:

- The drainage network,
- Hydrologic features like flood plains and wetlands,
- The source areas of sediment and organic material to insure of these materials are available to the stream and in quantities that are within the range of natural variation for the watershed. These source areas include riparian vegetation, streamside slopes, and headwalls.

The Key Watershed component of ACS fulfills the refuge aspect of this ACS Objective.

FEMAT (1993) identified several functions provided by the Riparian Reserve component of ACS. Table ACS-1 shows how the Riparian Reserve functions tie to the ACS objectives. Table ACS-2 shows width of stream side stand influence for each Riparian Reserve Function.

Table ACS-1: Riparian Reserve Functions and Meeting Aquatic Conservation Strategy Objectives

Riparian Reserve Functions	ASC Objectives to Maintain and Restore:								
	1: diversity & complexity of watershed & landscape	2: spatial & temporal connectivity	3: physical integrity	4: water quality	5: sediment regime	6: instream flows	7: flood patterns & watertable levels	8: riparian & wetland plant species composition & structural diversity	9: habitat for riparian-dependent species
root strength provided streambank stability			X	X	X	X		X	
large wood delivery to the streams	X	X	X	X	X	X	X	X	
large wood delivery to the riparian area	X	X						X	X
leaf & particulate organic matter input to the stream		X							X
water quality: temperature as affected by shade	X			X					X
riparian microclimate	X							X	X
water quality: sediment			X	X	X	X		X	
wildlife habitat	X	X		X				X	X

Table ACS-2: Width of Stream Side Stand Influence for Each Riparian Reserve Function
(Summarized from FEMAT 1993 pg V-26 to V-29. Additional discussion in the Density Management and ACS Chapter)

Riparian Reserve Functions	width of the zone of influence under current conditions	width of zone of influence in the old-growth forest
root strength provided streambank stability	½ tree crown diameter	½ tree crown diameter
large wood delivery to the streams	Within one tree height of stream	Within one site potential tree height of stream
large wood delivery to the riparian area	Within one tree height of riparian area	Within one site potential tree height of riparian area
leaf & particulate organic matter input to the streams	Within ½ a tree height of stream	Within ½ a site potential tree of stream
water quality: temperature as affected by shade	Within ½ a tree height of stream. Narrower under certain circumstances.	Within ½ a site potential tree of stream. Narrower under certain circumstances.
riparian microclimate	Up to three tree heights. Narrower under many circumstances.	Up to three site potential tree heights. Narrower under many circumstances.
water quality: sediment	Dependent on slope, soil type, and vegetation cover.	
wildlife habitat	Size and continuity can be species dependent. Quality of habitat is important.	

<u>The Aquatic Conservation Strategy Implementation in the North Fork Coquille Watershed:</u>

- The Upper North Coquille and Cherry Creek Drainages are the Tier 1 Key Watersheds in the North Fork Coquille Watershed.
- The interim Riparian Reserves in the North Fork Coquille include 19,275 acres or 52.3% of BLM land in the Watershed. When the LSR and the research natural area acres are added, 26,697 acres or 72.5% of the BLM acres in the North Fork Coquille Watershed are in one of the reserve land use allocations.
- Watershed analyses for the lands inside the North Fork Coquille were initially completed at the subwatershed scale. The initial watershed analyses for the Middle Creek, Fairview and North Coquille Subwatersheds were completed in 1995, and the initial analysis for North Coquille Mouth was completed in 1997. The North Fork Coquille Watershed analysis is a second iteration document that replaces the earlier subwatershed scale documents.
- Watershed restoration is on going, and accomplishments to date are summarized later in this chapter.

Key Watersheds

The Cherry Creek Key Watershed is the same as the Cherry Creek Drainage. The western boundary of the Upper North Fork Coquille River Tier 1 Watershed is different the Upper North Coquille drainage in that it excludes some private lands in the drainage. The acres of private land, BLM land and BLM land use allocations are shown in Table ACS-3. The ACS Appendix provides the miles of road, by land ownership, control and closure status, for the roads in the Cherry Creek and the Upper North Fork Coquille River Key Watersheds. That appendix data were used to calculate the 1994 road mileage baseline and the June 2001 road mileage presented in Table ACS-4, and Table ACS-5. Restoration accomplishments inside the are Key Watersheds are noted later in this chapter. Restoration recommendations for the Key Watersheds are given in the recommendations chapter.

Table ACS-3: Key Watershed Acres in the North Fork Coquille Watershed

	BLM Land by Land Use Allocation:					
Key Watershed	GFMA	LSR	RNA	Total BLM	Private land	Total all lands
Upper North Fork Coquille River	0	4,344	0	4,344	1,529	5,874
Cherry Creek	3,461	2,092	565	6,117	2,214	8,331

	Table ACS-4: Base Line Road Miles and Net Change in Road Miles, as of June 2001 for the Cherry Creek Key Watershed	miles for calculation purposes	miles for monitoring purposes	net change
	1994 road inventory base line for monitoring changes in road miles in the Key Watershed.		63.30	
+	New constructed roads on BLM administered land, and new constructed BLM controlled roads on non-BLM administered land from April 1994 to June 2001	0.00		
-	New constructed roads on BLM administered land, and new constructed BLM controlled roads on non-BLM administered land from April 1994 to June 2001	0.50		
=	June 2001 road inventory for purposes of monitoring changes in road miles in the Key Watershed		62.80	
?	Net change in road miles since April 1994			-0.50

	Table ACS-5: Base Line Road Miles and Net Change in Road Miles, as of June 2001 for the Upper North Fork Coquille River Key Watershed	miles for calculation purposes	miles for monitoring purposes	net change
	1994 road inventory base line for monitoring changes in road miles in the Key Watershed.		43.15	
+	New constructed roads on BLM administered land, and new constructed BLM controlled roads on non-BLM administered land from April 1994 to June 2001	0.04		
-	New constructed roads on BLM administered land, and new constructed BLM controlled roads on non-BLM administered land from April 1994 to June 2001	0.24		
=	June 2001 road inventory for purposes of monitoring changes in road miles in the Key Watershed		42.95	
?	Net change in road miles since April 1994			-0.20

Riparian Reserves

The original vision of the FEMAT scientists was watershed analysis would provide a geomorphic and ecological basis for stratifying the landscape into areas that would require Riparian Reserves that are wider or narrower than those prescribed for the interim. The FEMAT scientists observed that in the Oregon Coast Range debris flow originating in channel headwalls is the dominant mass movement process, whereas in the western Oregon Cascades rotational slumping is the primary form of mass movement. Given this difference, Riparian Reserves on intermittent streams, which are adequate to protect the aquatic and hydrologic functions on the typical Coast Range landscape, would tend to be narrow and distributed throughout the watershed. In contrast, locally extensive Riparian Reserves centered around earth flows would be more commonly appropriate for Cascade landscapes. Consequently, the post-analysis Riparian Reserve boundaries on intermittent streams needed to meet ACS objectives can be larger or smaller than the interim widths (FEMAT 1993, pg. V-39, V-44).

This vision that the Riparian Reserve widths would be adjusted following watershed shed analysis was brought forward into the ROD for the Northwest Forest Plan (USDI; USDA 1994b, pg. 7). This is clarified in the standards and guidelines: "Post-watershed analysis Riparian Reserve boundaries for permanently-flowing streams should approximate the boundaries prescribed in these standards and guidelines. However, post-watershed analysis Riparian Reserve boundaries for intermittent may be different from the existing boundaries. The reason for the difference is the high variability of hydrologic, geomorphic and ecological processes in a watershed affecting intermittent streams" (USDA; USDI 1994b, pg. B-13). Figure V-14, in the FEMAT document, indicates the range of post-watershed analysis Riparian Reserve widths what would provide the ecological protection needs for intermittent streams based on slope and rock type. The figure showing the ecological protection widths was brought forward into the basis for the standards and guidelines for the Northwest Forest Plan (USDA; USDI 1994b, pg. B-15). The dominant rock type in the eastern part of the North Fork Coquille Watershed is resistant sediment (sandstone) with small inclusions of intermediate sediment (siltstone) and unconsolidated material (landslide debris). The rock types in the western part of the Watershed include intermediate sediment (siltstone), resistant sediment (sandstone), other resistant (marine basalt) and unconsolidated materials (landslide debris and flood plain deposits)[2]. Table ACS-6 summarizes information from the FEMAT figure V-14 indicating the ecological protection widths for the common rock types in the Watershed.

Table ACS-6: Ecological Protection Widths for the Common Rock Types

	<30% slopes	30-50% slopes	50-70% slopes	>70%slopes
Resistant sediment (sandstone)	~35 feet	~50 feet	~80 feet	~100 feet
Intermediate sediment (siltstone, mudstone)	~38 feet	~63 feet	~100 feet	~125 feet
Other resistant (marine basalt)	~38 feet	~75 feet	~110 feet	~125 feet
Unconsolidated material (landslide debris, flood plains)	~80 feet	~110 feet	~150 feet	~175 feet*

* Flood plains are either flat or gently sloping. Land slide debris is the result of over-steepened slopes failing and trying to attain a stable slope (Easterbrook 1993). Consequently, landslide debris material rarely exceeds the angle of repose, which is about 68% for most soils in this area.

The interim Riparian Reserve widths for North Fork Coquille Watershed are based a 220-foot tall site potential tree (Introduction Appendix). We can modify those widths following one of the processes outlined in the Riparian Reserve Evaluation supplement to the Federal Guide for Watershed Analysis (Riparian Reserve Technical Team 1997). This is provided the revised widths allow for meeting or do not retard the attainment of ACS Objectives. A "level 1" analysis, using this watershed analysis, following specified parts of the site-scale analysis in the Riparian Reserve Evaluation supplement, and meeting the requirements for a NEPA site-scale analysis, would support changes in the Riparian Reserve on up to 10% of intermittent stream reserve acres in this Watershed. Riparian Reserve changes up to that scale present few risks to attain watershed scale objectives (Riparian Reserve Technical Team 1997). Larger changes to the Riparian Reserve will require the more comprehensive "level 2" analysis, which is also outlined in the Riparian Reserve Evaluation supplement to the Federal Guide.

<u>Riparian Reserve Widths and Objectives for Riparian Reserves in Addition to the Aquatic Conservation Strategy Objectives:</u> The FEMAT Terrestrial Group noted the "Riparian Reserves, especially those that provide buffers equal to a site potential tree on intermittent streams, provide ribbons of connectivity across landscapes. Just as importantly, for the many non-riparian organisms, they serve as additional acreage of

[2] The rock types are defined in Appendix V-G of FEMAT(1993).

Late-Successional Reserves" (FEMAT 1993, pg. IV-189). For example, Hershey and coauthors (1998) found 36% of northern spotted owl nest sites on the lower third of slopes, 58% on the middle third, and only 6% of the nest sites on the upper third. Riparian Reserves generally include all of the lower and much of the midslope positions, in the Oregon Coast Range, due to the combination of tall site potential trees, short slope lengths, and high stream density. The Northwest Forest Plan includes objectives for the Riparian Reserves that are in addition to the Aquatic Conservation Strategy. These are providing habitats and connectivity for late-successional associated species. The land use allocation description in the Northwest Forest Plan ROD notes that in addition to protecting riparian and aquatic species and habitats, the Riparian Reserves ". . . also provide incidental benefits to upland species. These reserves will . . . enhance habitat conservation for organisms dependent on the transition zone between upland and riparian areas, improve travel and dispersal corridors for terrestrial animals and plants, and provide for greater connectivity of late-successional forest habitat" (USDA; USDI 1994b, pg. 7). The basis for the standards and guidelines for the components of the Aquatic Conservation Strategy states "[w]atershed analysis should take into account all species that were intended to be benefitted by the prescribed Riparian Reserve widths. These species include fish, mollusk, amphibians, lichens, fungi, bryophytes, vascular plants, American marten, red tree voles, bats marbled murrelets, and northern spotted owls" (USDA; USDI 1994b, pg. B-13). Many of these species are not restricted to riparian forest habitat, but they do use a variety of habitats inside the Riparian Reserve for drinking, feeding, roosting, nesting (Riparian Reserve Technical Team 1997). The additional species analysis, contained in FSEIS Appendix J2 concluded that the viability of several species, which are assumed to benefit from late-successional forest conditions, is provided by Riparian Reserves widths of a site-potential tree either side of intermittent streams but not provided by widths equal to half a site potential tree (Holthausen *et al.* 1994).

Based on the administrative record cited above, the ecological protection needs would be typically met on intermittent streams on Tyee sandstone with Riparian Reserve widths of about 35 to 100 feet. However, when certain Appendix J-2 listed late-successional associated plant, and wildlife species are found at a site where Riparian Reserve width reduction is considered, an assessment the species's watershed scale distribution and abundance would be needed. That assessment would determine if reducing the interim Riparian Reserve widths on that site would be consistent with the underlying assumptions for viability of the Appendix J-2 species under the Northwest Forest Plan.

<u>Restoration Through Stand Treatments in the Riparian Reserves:</u> The most important components of the restoration part of the Aquatic Conservation Strategy ". . . are control and prevention of road-related runoff and sediment production, restoration of the conditions of the riparian vegetation, and restoration of in-stream complexity. Other restoration opportunities exist, such as meadow and wetland restoration and mine reclamation, and these may be quite important in some areas" (USDA; USDI 1994b, pg. B-31). The basis for the standards and guidelines elaborates on the riparian vegetation restoration component as follows: "Active silvicultural programs will be necessary to restore large conifers in Riparian Reserves. Appropriate practices may include planting unstable areas such as landslides along streams and flood terraces, thinning densely-stocked young stands to encourage development of large conifers, releasing young conifers from overtopping hardwoods, and reforesting shrub and hardwood-dominated stands with conifers. These practices can be implemented along with silvicultural treatments in upland areas, although the practices will differ in objective and, consequently, design"[3] (USDA; USDI 1994b, pg. B-31). This is translated into the following standard and guideline: "Apply silvicultural practices for Riparian Reserves to control stocking, reestablish and manage stands, and acquire desired vegetation characteristics needed to attain Aquatic Conservation Strategy objectives" (USDA; USDI 1994b, pg. C-32).

[3] Experience to date shows that while the management objectives for the Matrix and the Riparian Reserves may be different, many habitat restoration practices initially prescribed for the Riparian Reserve are also applied to the Matrix sites when those treatments do not prevent attainment of Matrix objectives.

The Riparian Reserves embedded in the Late-Successional Reserves are managed to meet both Riparian Reserve and Late-Successional Reserve objectives (USDA: USDI 1994b, pg. C-1). The FEMAT scientists concluded that management intervention within Reserves[4] may hasten restoration of late-successional conditions. They also concluded management activities are appropriate where past activities, like fire suppression, jeopardize old forest conditions and supported treating plantations to put them on a trajectory to develop late-successional forests conditions (FEMAT 1993, pg. IV-187). The option of relying on passive restoration in the Late-Successional Reserves was incorporated into alternative 1 and analyzed in the FSEIS. While alternative 1 was found to provide a high level of protection for late-successional habitat, it was ultimately rejected because assessment team believed that without restoration silviculture, the development of additional late-successional conditions would be retarded (USDA; USDI 1994a, ch. 2 pg. 69).

Large diameter trees, down wood, and snags are characteristic of late-successional forests (Franklin *et al.* 1986; Franklin & Spies 1991). The value of thinning is to concentrate growth on selected trees (Daniel *et al.* 1979; primary sources summarized and cited by Oliver & Larson 1990). Age class distributions and growth rates observed by examining stumps suggested to Franklin and Hemstrom (1981) that old-growth stands developed at low densities and had long regeneration periods. They concluded that either extensive repeated fires reduced the seed sources, or partial burns could account for the low stocking condition and age ranges observed by counting and measuring old-growth tree rings. Tappeiner *et al.* (1997) observed old-growth trees often averaged 20-inches dbh at age 50 and 40 inches at age 100. This individual growth rate is higher than observed in plantations today. By running stand development simulations, Tappeiner and coauthors (1997) found 31 to 46 trees/ acre, at age 20-years, resulted in the better fit to observations made in old growth stands with respect to the estimates of total densities and densities of the larger diameter classes. This suggests that the old-growth stands developed with low density, regenerated over time, and had little inter tree competition. Poage (2000) came to similar conclusions after examining data for the Coast Range, Oregon Cascades, and Willamette Valley.

<u>Riparian Reserve Functions, Late-Successional Conditions and Meeting the Aquatic Conservation Strategy</u>: The Standards and Guidelines (USDA; USDI 1994b) do not specifically direct managing the Riparian Reserves for late-successional forest conditions to meet the Aquatic Conservation Strategy. However, when the FEMAT team defined the functions of stream side vegetation, with respect to benefits to in stream and riparian habitats, they used research on late-successional forest influences on stream and riparian habitats (primary sources cited in FEMAT 1993, pgs. V-26 to V-29). Indeed, the interim Riparian Reserve widths are defined as a function of the "average maximum height of the tallest dominant trees (200 years or older)" (USDA; USDI 1994b, pg. C-31). Consequently, obtaining the several functions of the Riparian Reserve requires managing for late-successional forest <u>attributes</u>, if we are to maintain consistency with the conditions and assumptions used in the FEMAT document to develop and support the Aquatic Conservation Strategy.

Three functions of the Riparian Reserve are contingent on the presence of large diameter trees: large wood delivery to streams, large wood delivery to riparian areas and wildlife habitats (FEMAT pgs V-26, V-29). Wildlife habitats associated with large diameter trees include large diameter snags, large diameter down wood, prey substrates provided by large surface areas of coarse deep fissured bark, deep canopies, large limbs, and large platforms, cavities and other structures found in damaged or injured large trees (Brown *et al.* 1985; Weikel & Hayes 1997). Large trees, large snags, large down wood and large deep crowns are all attributes associated with late-successional forests (Franklin *et al.* 1986) and spotted owl habitat (North *et al.* 1999).

The ability of the Riparian Reserve to maintain cool water temperatures by shading streams depends on stream width, vegetation height, and the angular density of foliage. Tall vegetation will provide more shade to

[4] The source sentence in the FEMAT document did not specify Riparian Reserve nor Late-Successional Reserve. The larger context is a discussion on the Late-Successional Reserves. However, the Riparian Reserves were observed in that discussion to provide linkage among the Late-Successional Reserves (FEMAT 1993, pg IV-186 to IV 188).

a wide stream than short vegetation. On streams where the vegetation heights are sufficient to cast shadows across the channel, the canopy of a stand in the stem exclusion stage of stand development will provide more shade than the more open overstory canopy typical of a late-successional stand (Oliver & Larson 1990). However, multi-canopy-layered multi-species late-successional forests provide redundant layers of foliage intercepting light. These species diverse and structurally complex stands are more robust in their ability to continue to provide shade following disturbance than are stands in the stem exclusion stage of stand development that have only a single vegetation layer and limited species diversity. In a study on the H. J. Andrews, Levno and Rothacher (1969 cited in Adams; Ringer 1994) found stream temperatures increased 12 to 14°F following clearcut logging of old-growth, slash burning, and stream cleaning. However following logging, but before the understory vegetation was removed by burning, the maximum stream temperatures increased 4°F. In contrast, few if any understory herbs and shrubs are present under a stand that is the stem exclusion stage of stand development that could provide shade following removal of the trees.

Similarly, late-successional forests conditions are not essential to the function of the Riparian Reserve to provide root strength for stream bank stability or protect water quality from erosion. These functions can be met by stands in earlier seral stages. However, the multiple vegetation layers and higher species richness do provide redundant mechanisms that allow late-successional stands to tolerate disturbance better and thus retain the ability to fulfill these functions following disturbance better than stands in the stem exclusion stage of stand development.

Another function of the Riparian Reserve is to provide leaf and other particulate organic matter input to streams is benefitted by a diverse range of plant species. In addition, the greater the range of plant species, the greater the variety of arthropods likely present that could as fall into the stream along with particulate plant matter. The multi-vegetation layered late-successional forests inherently have a greater abundance of understory tree shrub and herb layer plants and typically greater species richness than stand in the stem exclusion stage of stand development.

Watershed Restoration

<u>Active Restoration Accomplishments:</u> The following tables display restoration projects in the North Fork Coquille since 1994. Restoration projects in Key Watersheds are indicated by “KW.” Restoration projects where only a part of the treatment area is inside a Key Watershed are indicated by “pt. KW.”

Stream Crossings-

Map ACS-1 shows where roads cross third order and larger streams, and also shows culvert replacement needs, and accomplishments. The tables in this subsection show stream crossing improvement accomplishments.

Table ACS-7: Large Stream Crossing Structure Upgraded to Allow/ Improve Passage for Fish and Other Aquatic Species

Creek	Road	Year	Diameter	Length		Notes
Bay Ck.	Middle Ck. Rd.	FY94	96 in.	106 ft.		CMP with fish weirs
Coak Ck.	Middle Ck. Rd.	FY94	96 in.	80 ft.		CMP with fish weirs
Mast Ck.	Middle Ck. Rd.	FY94	96 in.	64 ft.		CMP with fish weirs
Honcho Ck.	Middle Ck. Rd.	FY94	84 in.	50 ft.		CMP with fish weirs
Unnamed Woodward Ck. trib.	Woodward Ck. Rd.	FY97	60 in.	70 ft.		CMP with baffles and weirs
Unnamed Cherry Ck. trib.	Cherry Ck. Mainline	FY98	117X79 in.	70 ft.	KW	CMP with baffles
Moon Ck.	Moon Ck. Rd.	FY99	142X91 in.	82 ft.		CMP with fish weirs & bat box

Wyden Amendment Projects on private lands - culverts replacement:

Replaced 2 culverts with bridges on a private reach of Wimer Creek in FY99.

Replaced 1 culvert where county road crossed Wimer Creek in FY99.

Table ACS-8: Ditch Relief Culvert Replacement

Road	Miles of Rd.	Yr.		Notes
No. Fk. Ridge Rd., 27-10-6.0	7.4	FY 94	pt. KW	20 ditch relief culverts replaced. 2 nonfish bearing stream crossing culverts replaced/ upgraded. On boundary with So. Fk. Coos Watershed.
No. Fk. Coquille Rd., 25-10-30.0	1.65	FY 94	pt. KW	8 ditch relief culverts replaced inside the No. Fk. Coquille Watershed. 2 nonfish bearing stream crossing culverts replaced/ upgraded.
Middle Ck. Rd., 27-11-29.0	14.25	FY 94		48 ditch relief culverts replaced. 12 nonfish bearing stream crossing culverts replaced/ upgraded.
Burnt Mtn. Rd., 27-11-12.0	5.8	FY 94		18 ditch relief culverts replaced. 3 nonfish bearing stream crossing culverts replaced/ upgraded.
Moon Ck. Rd., 26-11-33.0	3.53	FY 94		10 ditch relief culverts replaced. 6 nonfish bearing stream crossing culverts replaced/ upgraded.
Cherry Ck. Mainline, 27-11-27.0	6.55	FY 96	KW	14 ditch relief culverts replaced. 13 nonfish bearing stream crossing culverts replaced/ upgraded.
Cherry Ck. Ridge Rd., 27-11-23.0	4.52	FY 96	pt. KW	17 ditch relief culverts replaced. 2 nonfish bearing stream crossing culverts replaced/ upgraded.
No. Fk. Cherry Ck. Rd., 27-10-18.0	1.9	FY 96	KW	11 ditch relief culverts replaced. 4 nonfish bearing stream crossing culverts replaced/ upgraded.
Vaughns Ck. Rd., 27-10-6.1 & -6.3	2.13	FY 96		19 ditch relief culverts replaced.
Vaughns Ck. Rd. 27-10-4.0	0.33	FY 96		1 ditch relief culverts replaced. 1 nonfish bearing stream crossing culverts replaced/ upgraded.
No. Fk. Coquille, 25-10-30.0	---	FY 96	KW	1 culvert installed to return a diverted non fish bearing stream to its original channel. Replacement may have been FY 95
Woodward Ck. Rd., 27-12-14.0	3.31	FY 97		34 ditch relief culverts replaced

Road surfaces and sediment delivery control -

Map ACS-2 shows BLM Roads by surface type. Map ACS-3 shows decommissioned roads in the Watershed and the additional roads proposed for decommissioning. The tables in this subsection list road surfacing projects and list the roads decommissioned as of July 2001.

Table ACS-9: Road Surfacing to Control/avoid Sediment Delivery from Road Surfaces

Road	Miles	Year		Notes
Middle Ck. Rd., 27-11-29.0	3	FY94		contract project
No. Fk. Ridge Rd., 27-10-6.0	3	FY94	pt. KW	On boundary with South Fk. Coos Watershed - contract project
Woodward Ck., 27-12-14.0	3.31	FY97		Base coarse added to natural surface road - Jobs-in-the-Woods project

Table ACS-10: Miles of BLM Controlled Roads Decommissioned in the North Fork Coquille in 1994 and Later

Key Watershed	Road	control	Miles calculated from GIS line data	year built	year decommissioned	Notes
Cherry Ck	27-10-29.5	BLM	0.02	not known	2000	Long term decommission
Cherry Ck	27-11-26.1	BLM	0.34	not known	1997	Full decommission
Cherry Ck	28-11-03.0 M Cherry Ck. CCC Rd.	BLM	0.14	not known	2000	Long term decommission
Total miles in Cherry Ck Key Watershed			0.50			
U N Fk Coquille R	26-10-23.7	BLM	0.24	not known	1998	Long term decommission
Total miles in the Upper No. Fk. Coquille R. Key Watershed			0.24			
–	26-10-6.0 D Alder Ck. Rd.	BLM	1.44	not known	1999	Long term decommission. A large culvert removed from where road crossed Alder Ck. Potential future work would be to remove fill from flood plain.
--	27-11-17.3	BLM	0.24	1996	1996	Long term decommission
--	27-11-17.4	BLM	0.15	1996	1996	Long term decommission
--	Spur 1 TS 96-04	BLM	0.10	1996	not recorded after 1996	Long term decommission
--	Spur 4 TS 96-04	BLM	0.05	1997	not recorded after 1997	Long term decommission
–	unnamed spur	BLM	0.20	not known	2001	Full decommission
–	28-11-19.03A	BLM	0.17	not known	2001	Full decommission
--	28-11-19.03C	BLM	0.20	not known	2001	Full decommission
Total miles outside of Key Watersheds			2.55			
Total miles for the North Fork Coquille 5th field Watershed			3.29			

Instream projects-

Table ACS-11: In Stream Project Accomplishments

In Stream Project	Location	year	notes
No. Fk. Coquille Root Wad Placement	sect. 4, T27S, R11W	FY94	includes placement of 2 myrtles in stream
No. Fk. Coquille Boulder Weir Renovation	sect. 4, T27S, R11W	FY94	
No. Fk. Coquille Spawning Gravel Placement	sect. 4, T27S, R11W	FY94	320 tons of gravel/ weir
Middle Ck. Root Wad Placement	sect. 14 & 15, T27s, R11W; sect. 4 & 5, T27s, R10W	FY94	
Middle Ck. Boulder Weir Renovation	sect. 14 & 15, T27s, R11W; sect. 4 & 5, T27s, R10W	FY94	
Middle Ck. Weir Construction	sect. 14 & 15, T27s, R11W; sect. 4 & 5, T27s, R10W	FY95	5 weirs
Middle Ck. Spawning Gravel Placement	sect. 14 & 15, T27s, R11W; sect. 4 & 5, T27s, R10W	FY95	gravel placed behind 5 weirs
Middle Ck. Root Wad Placement	same areas as boulder weirs	FY95	24 root wads
Middle Ck. Off Channel Pond	sect. 12, T27S, R10W	FY95	1 pond
Middle Ck. Side Channel Improvement	sect. 15, T27S, R10W	FY95	boulder weir repair & root wad placement

In Stream Project		Location	year	notes
No. Fk. Coquille River Tree lining	KW	sect 16, T26S, R10W	FY96	8 sites
Hudson Ck.		Sect. 09, T27S, R11W	FY97	1 vortex weir, log placement, root wad placement.
Cherry Ck. Mainstem Log Placement	KW	sect. 23 T27S, R11W	FY99	20 logs placed
Moon Creek			FY99	log placement
Bay Ck.		sect. 29, T27S, R11W	FY99	roadside hazard trees felled into creek to serve as habitat.
note: Additional instream projects were installed in Middle Creek and Moon Creek before the Forest Plan				

Table ACS-12: Log Jam Repositioning[5]

Stream	Location	Year	Notes
Park Ck.	sect. 4, T27S, R10W	FY99	A windfall into Park Ck. redirected stream flow in a way that cut a new channel and accelerated stream bank erosion inside the Park Ck. Rec. Site. The windfall was moved downstream and large woody debris on site was rearranged to deflect stream back into original channel and turn the newly eroded channel into back channel habitat that can provide a refuge for fish during high flows.

Stand treatment projects inside the interim Riparian Reserves-

Table ACS-13: Conifer Reestablishment in Riparian Areas*

Project Site	Unit		Acres	Type	Well-spaced tree/ac.
Moore Ck.**	27-10-03-100		10	Conversion/ underplant 1994	75
Old Man's Rd.	27-11-13-901		5	Conifer released 1994	No data
N Fk. Cherry Ck. Rip #1	27-10-20-901	KW	8	Conifer released 1994	No data
17.0 Regen Rip	26-10-07-901		6	Conversion & conifer planted 1996	485
N Fk Cherry Ck. Rip #2	27-10-20-902	KW	6	Hdwds girdled & underplanted 1996	400
N Fk Cherry Ck. Rip #2	27-10-20-903	KW	2	Conversion & conifer planted 1996	400
Cherry Ck. Ridge Rip	27-11-23-901	KW	12	Conversion & conifer planted 1996	16
Cherry Ck. Ridge Rip	27-11-24-901	KW	2	Conversion & conifer planted 1996	16
Little NFC Ext Rip	26-10-19-901		6	Conversion & conifer planted 1996	300
Gatewood Rip	26-10-17-901		1	Conversion & conifer planted 1997	91
Alder Ck. # 1	26-10-30-901		9	Conversion & conifer planted 1997	320
Alder Ck. # 1	26-10-30-901		1	Conversion & conifer planted 1997	320
Alder Ck. # 2	26-10-30-151		3	Conversion & conifer planted 1997	156
Johns Ck. Rip	29-11-07-210		13	Conversion & conifer planted 1999	100
Mungers Rd. Rip	27-10-05-901		6	Conversion & conifer planted 1996	260
* This list includes only those projects initiated specifically as riparian vegetation projects. This watershed also contains units regenerated following harvest of timber sold before the NW Forest Plan went into effect. ** The Moore Creek Project was started in 1992 before the Forest Plan however the nature of the project required additional investments in and after 1994					

[5] Note: Log jam repositioning is not restoration activity in the strictest sense. Rather the intent of these projects is to rearrange log jams that cause damage to roads, parks or improvements in a way that eliminates the threat to improvements while preserving the beneficial functions on the jam for instream habitat and hydrologic function. Before adoption of the Aquatic Conservation Strategy, these jams would have been removed.

Other Riparian projects were started before the Northwest Forest Plan took affect. These include:

Conifers were released in 1993 on the 5 acre 17.0 Riparian Release Unit, 26-10-17-902.

Conifers planted in association with the 1994 weir project on Moon Creek.

Conifers planted in association with the 1992/93/97 boulder weir projects on Middle Creek.

Table ACS-14: Density Management Inside Riparian Reserves

Sale Name	Gross acres	Reserve acres	Year Completed	Notes
Woodward Thin	235	117±	FY99	
Hudson	242	121±	FY99	
Woodward 1-11	425	212+	in progress	fish passage culvert to be installed under this contract

Passive Restoration: Riparian Reserves include 52.3% of BLM land in the Watershed. The portions of the Late-Successional Reserve and research natural area outside the Riparian Reserves include 19.5% and 0.7% of BLM lands respectively. Together, 72.5%, or 26,697 acres of the BLM lands in the Watershed are in either in a reserve or in the research natural area. The conifer stands and natural hardwood sites on these acres are not available for clearcut harvest under the Forest Plan. Alder stands that came in following management associated disturbance on sites formerly occupied by conifers in the Riparian Reserves and Late-Successional Reserves are available for regeneration harvest if done to restore conifers to those sites. An estimated 1,500 acres of alder stands in this Watershed are likely to be regeneration harvested. An estimated 1,000 acres of those alder stands are in the Riparian Reserve[6]. Based on that assumption, at least 25,200 acres will prove the passive restoration benefits associated with a continuous forest cover. That represents a little more than 68% of BLM land in the Watershed. The LSR and Riparian Reserves are managed for late-successional/ old-growth habitat, and for protection of hydrologic function and aquatic habitats respectively.

This Watershed includes 7,842 acres of LSR land and 565 acres of research natural area land that supports 80-year old and older stands. This represents nearly 23% of the BLM land in the Watershed. We are not planning to apply density management treatments to LSR stands older that 80-years. This is consistent with the LSR Assessment recommendations (USDI; USDA 1998). Since implementation of the Forest Plan in 1994, active manipulation of stream side stands on the Umpqua Resource Area, which are older than 80-years, has been limited to cutting and line pulling trees to restore large CWD to those streams.

Areas in many stands that could benefit from a density management treatment will not be thinned or will only be lightly treated because we will use no-cut buffers to protect known sites occupied by certain survey and manage, and T&E species. We also will use a combination of no-treatment and light-treatment zones along streams, as needed, to assure near term attainment of some Riparian Reserve functions.

The rate at which we attain restored conditions through passive management depends on the function considered. Table ACS-15 contains estimates of when we will attain recovery of various Riparian Reserve functions and the basis for those estimates.

Table ACS-15: Estimated Recovery Rates of Riparian Reserves with Regards to Function Assuming Passive Restoration (No Active Management to Shorten Recovery Time)

[6] The FOI data base shows 2,888 acres of hardwoods on BLM land in the Watershed. Of that, 1,512 acres have birth dates after 1949 and likely regenerated following harvest or road construction. The FOI data shows 1,928 acres of hardwoods in the Riparian Reserve, of which 928 acres have birth dates after 1949. For comparison, an analysis of 1993 Lansat data shows 2,380 acres of hardwoods inside the Riparian Reserve. The Lansat data includes areas represented by single 30-meter by30-meter pixels. The FOI data generally includes polygons that are 5-acres and larger. Operational considerations will result in most alder conversion work occurring in stands that are 5 acres or larger, few if any in stands 2 acres or smaller will be targeted for conversion using a regeneration cut. Conversions of alder stands that are less than 5 acres generally will not be done as stand alone projects but rather as a part of other projects. A portion of these hardwood acres are in myrtle and big-leaf-maple stands. The myrtle and maple stands will not be converted to conifer but rather will be retained for habitat and landscape diversity purposes.

Riparian Reserve Function	Condition	Estimated Recovery Rate and Supporting Notes
slope stability/ sediment delivery	Increased landslide risk associated with loss of root strength following clearcutting Highest risk sites are characterized by shallow soils on steep slopes.	Increased risk of landsliding occurs during the 10 to 15 years following clearcutting (Swanson *et al*. 1977). Coast Range data indicates the greatest risk of in-unit landsliding occurs in first 3 years following clearcutting (Gresswell *et al.* 1976). The peak risk period (first 3 years after cutting) has passed for the units that were clearcut harvested before the initiation of the Forest Plan in 1994. Root strength will recover to preharvest levels in about 15 years. We expect full passive recovery of slope stability, as controlled by root strength, between the years 2009 and 2014 for all BLM lands in the LSR and RR. Shallow rapid type landslides are unlikely on land with deep soils on slopes that are less than the angle of repose.
shade	Harvesting to the stream edge exposes the stream to solar heating	Stream width controls the rate of passive recovery. Ten years after clearcutting, vegetation regrowth along Coast Range streams that are less than 10-feet wide (generally 1st, 2nd, and 3rd order streams) will provide shade levels equal to that in mature stands (Summers 1982 cited in Skaugset 1992). Therefore, full passive recovery for small streams inside BLM clearcut units will occur about year 2004. During the 1970's hardwood buffers and hardwood-cedar-hemlock buffers were left next to fish bearing streams following clearcutting on BLM land. Beginning in the early 1980's, BLM timber sales units next to all 3rd order and larger streams, and next to fish bearing 2nd order streams included no-cut stream buffers. These buffers were 80-feet and wider on either side of the stream. These buffers provide passive restoration, with respect to shade on those streams (Brazier; Brown 1973). Before the 1970's, clearcutting down to the stream edge was a common practice on all streams. The youngest of these 2nd growth stream side stands is about 30-years. A 30-year old Douglas-fir stand on an average site will be 78 feet tall (McArdle 1961; site index calculation in the Introduction Appendix). Full recovery of vegetation, for shade purposes, has occurred along those 1st to 5th order streams over the last 30 years. Review of old aerial photographs that show the pre-logged stand condition stream side forests indicates that the 8th order, and the larger 6th and 7th order stream channels in the Watershed are too wide to be fully shaded from above by streamside trees. Those photographs also suggest that channel migration on flood plain reaches will create canopy gaps above 4th and 5th order streams (Water Quality Chapter.)
coarse woody debris	Harvesting to the stream edge and aggressive stream cleaning has resulted in a loss of instream structure and a lost potential to recruit new large structure from the stream side stand.	See the cell above for stream buffer history. Without active management, green tree average dbh of 20-inches is attained at stand age 70 to 110-years. Passive recovery of the potential to regularly recruit dead trees that average 20-inches dbh and larger from stream side stands will take approximately 120 to 180 years from the time the stream side stand was regenerated. Recovery rates controlled by initial stand density, uniformity and site quality. The assumptions and analysis are in Density Management and Conversion Treatments and attaining Riparian Reserve Functions section of this document. We expect passive recovery of the potential to regularly recruit large wood, along non-fish bearing 1st and 2nd order streams, to occur between the years 2114 and 2174. We expect passive recovery along fish bearing streams between the years of 2094 and 2154. Large diameter wood is attainable earlier in low stocked sites. The Riparian Reserve contains 42 acres of brush fields that established following logging. These brush fields are not growing trees or delivering wood to the stream, and without disturbance, that will not change. Without active management, and barring high severity disturbance, approximately 1,000 acres of alder stands will in time mature, breakup and die. Alders peak in net volume about age 90 and begin declining shortly thereafter with few alders surviving past stand age 130 years (Newton & Cole 1994). This will result in a pulse of nondurable wood to the stream followed by a decline of wood delivery on affected stream reaches. The decline and breakup period for the alder stands regenerated after 1949 will begin after 2090. The last wood delivered to the streams by the youngest alder stands, with birth dates about 1980, can be as late as 2110.

Riparian Reserve Function	Condition	Estimated Recovery Rate and Supporting Notes
edge effect	Placement of a recent clearcut next to an established stand results in an edge. This in turn causes microclimate changes that reach into the established stand. Given certain site conditions (gentle uniform slopes, little understory, favorable aspect), wind can penetrate into an old-growth stand for a distance equal to 3 tree heights. Chen (1991) found edge influences on biological variables ranged from essentially none to 450 feet for hemlock seedlings $\leq$10 cm tall.	No new streamside regeneration units will be created under the Forest Plan except where brushfield and hardwood conversions are accomplished to restore Riparian Reserve function. Fire, blowdown, or other natural disturbances will create new stand edges and may necessitate future regeneration units next to streams. Where we have existing clearcuts, we attain passive recovery from microclimate changes due to edge effect in older stands as the adjacent clearcut reforests and that new stand grows tall enough to shield the gap between the ground and the base of the crowns of the trees in the older stand (Harris 1984). The establishment and growth of understory trees beneath the older trees along the edge also facilitate passive recovery. The time required for a young plantation to grow tall enough to block the gap below the crown of an adjacent stand depends on the size of the gap and the site quality. Assuming a Kings 50-year site index of 126 ft, and assuming the older stand is 192 feet tall, an adjacent plantation will shield the gap below the older stand's crown in 47-years if the older stand has a 40% crown depth and in 23-years if the older stand has a 70% crown depth (the analysis is in the Density Management and Conversion Treatments and attaining Riparian Reserve Functions section of this document). We expect passive recovery with respect to microclimate edge effect associated with past clearcutting inside what is now reserve lands in about year 2038 to 2048.

<u>The Passive/ Active Roles of Density Management</u>: Density management affords a means to do both active management (speed or assure attainment of late-successional stand attributes and large trees that are suitable for recruitment as large riparian/instream structures), and provide passive restoration through maintenance of continuous forest cover (thus assuring the benefits of root strength for streambank and hill slope stability, nutrient cycling, and shade).

Density management treatments applied to younger stands are more effective at setting stands on a trajectory to become old growth, at attaining large stem diameters, for developing wind firmness, and retaining deep crown depths than are late entries. Density management in older stands is more appropriate for attaining a strong size contrast between the overstory and understory trees in a stand, and to tweak the stand thereby recruit attributes like large snags, large down wood, and canopy gaps. Density management for habitat benefits is a relatively young concept. Thus, techniques are evolving, and treatment objectives can change from project to project depending on what we learn from earlier treatments and from the current literature, and on the site specific conditions.

The science behind retaining untreated buffers along streams and other areas of concern, to provide passive protection, is rooted in research done in the 1960s and 1970s to protect streams from the impacts that clearcuts had on aquatic/riparian habitats (see the Erosion Processes, Water Quality and the Density Management Chapters for research summaries and citations). Consequently, the underlying science supporting buffers is based on studying the contrast between conditions inside a buffer zone and an adjacent clearcut. We are unaware of any research specifically examining the contrasts between the thinned and unthinned areas within a stand, with respect to identifying adverse treatment impacts that require buffers as mitigation. Instead, the current research efforts focus on how to redirect managed stand growth trajectories to more closely follow the observed trajectory followed by old growth stands, and on how to attain large diameter conifers suitable for recruitment as riparian/instream structure through either stand conversion, release treatment, or thinning. Current research efforts are also exploring how well thinned young stands provide various habitat values when compared with late-successional/ old-growth stands and to unthinned young stands (the Density Management Chapter contains research summaries and citations). This implies researchers and those that fund research see the information needs supporting long term restoration of streamside stand structure and diversity as a more critical data gap.

A review of literature concerning buffers, and an analysis of a range of treatments that we may apply next to streams, suggests a light treatment area equal in width to half the height of the dominant trees in the current stand will insure near term attainment of the passive restoration benefits of shade and litter input, and a no treatment buffer equal to about half the average tree crown width will provide stream bank protection via root strength (see the Assessment of Density Management and Attainment of Riparian Reserve Functions section of this document for the literature review and citations). Conversely, this suggests we can use a more aggressive active management, such as wide-spaced thinning prescriptions, in those parts of stands that are farther back from the stream edge. This would allow more rapid attainment of desired late-successional stand conditions in the long term without adversely affecting short term attainment of those streamside functions attainable through passive management. Some sites have slope, topographic shading, aspect, or other physical attributes that shade or otherwise protect streams. On these sites, where physical features protect streams from direct sun, narrower buffers can provide passive protection of other riparian functions. Considering these physical features would allow the flexibility to use active management to restore CWD recruitment potential, species diversity, and structural complexity nearer to the streams on those sites. The supporting analysis is in the Assessment of Density Management and Attainment of Riparian Reserve Functions section of this document.

Thinning/ density management are partial cut systems where live trees are retained on the site. These live trees provide a live root mass that binds the soil together and thus these cutting systems do not increase the risk of mass movement on slide prone ground associated with clearcutting. The amount of live root mass, following a partial cut, is greater than would be indicated by the number of live trees alone. Eis (1972) found 45% of the selectively cut Douglas-firs were root grafted and half those stumps were still alive 22 years later. In addition, the roots of different trees in the stand are intertwined, unlike the tree crowns, which are spatially distinct. Consequently, thinning does not kill all the roots in the discrete areas of soil below the cut trees (Stout 1956 cited in Oliver & Larson 1990).

<u>Effects of "no-action alternatives" and "wide no-treatment buffers"on Attainment of ACS Objectives</u> - The Douglas-fir old-growth forest, along with its associated aquatic habitats, are disturbance dependent ecosystems (Agee 1981, Reeves *et al.* 1995). The optimal conditions for the development of late-successional/ old-growth habitats include disturbances that cause short term detrimental impacts on habitat attributes used by individual species. Consequently, maximizing attainment of individual habitat attributes by excluding or avoiding disturbance can delay attainment of overall late-successional/ old-growth conditions for decades to a century or more. In other terms, selecting the "no-action alternative" for a densely stocked stand would have a "likely to adversely affect" on species that benefit from late-successional forest conditions. These late-successional conditions include the large diameter down wood that contribute to instream structure and aquatic habitats.

Density management can be used to emulate low to moderate severity natural disturbances without the associated risk of stand replacement that accompanies wildfire. Avoiding the risk of stand replacement fire is particularly important on landscapes where uncontrolled fire poses a risk to both the remaining old-growth patches on BLM land and to adjacent private property values. Density management effects are highly controllable, allowing managers to target those parts of the landscape that can best benefit from treatment. Managers can also selectively moderate treatment intensity or leave some areas untreated, and by that moderate or avoid short term impacts to particularly sensitive areas. This allows attainment of several objectives across a stand that would be mutually exclusive at the acre scale. The problem for biologists designing density management projects is deciding where in the stand to apply the different intensities of treatment in order to avoid short term risks to sensitive areas and still attain the long term objectives. A decision to use a no-treatment buffer around sensitive areas may to be prudent in light of short term effects, and using an extra wide buffer can seem good insurance. However, wider that necessary no-treatment buffers do not provide additional short term protection, and carry the cost of delaying attainment of those stand conditions associated with late-successional forest that benefit aquatic systems.

The following describes one example of the tradeoff between short term protection of a habitat attribute and long-term restoration of an ecosystem: Overhead shading of the streams by streamside vegetation is desirable for maintaining the aquatic habitat attribute of cool water temperatures. Maximum shading, resulting in the lowest possible solar heating of streams, occurs during the stem exclusion stage of stand development. Stands do not develop many of the attributes of old-growth, like deep multilayered, multi-aged, multi-species canopies, until after the stands emerge from the stem exclusion stage and enter the understory reinitiation stage. The understory reinitiation stage is made possible by the formation of canopy gaps that allow enough light to reach the forest floor to support survival and growth of understory trees shrubs and herbs (Oliver; Larson 1990). The longer the stand remains in the stem exclusion stage, the later the stand will develop late-successional attributes. The stem exclusion stage is also a period of intense competition, which slows tree diameter growth rates. Work by Tappeiner and coauthors (1997) suggests the Coast Range stands that survived to become old-growth grew under low stocked conditions when young. Low stocking levels allowed those stands to accrue much of their diameter growth when young. That suggests maintaining high stocking levels causes the current stands to develop along a different trajectory than did the stands that survived to become old-growth under unmanaged conditions. These more open growing conditions probably allowed for earlier recruitment of understory vegetation, and development of deeper crowns associated with old-growth than would be possible for the current will-stocked and overstocked stands if those stands were left to develop without either thinning or moderate severity natural disturbance.

If we were to ignore effects of managing for habitat attributes at the expense of restoring ecosystem processes, we would still have situations where maximizing the attainment of one desired habitat attribute can delay attainment of other desired habitat attributes. Returning to the example above, managing for the lowest possible solar heating of streams by retaining high streamside stocking levels in streamside stands to can delay attainment of large average diameter streamside trees. This in turn delays regular attainment of another habitat element, the large instream key pieces of wood. How big an impact this is depends in large part on the width of the no-treatment area. Based on work by McDade and coauthors (1990), 11% of all debris found in streams originated within 1-meter (~3-feet) of the stream and was likely recruited by streambank erosion undermining and toppling trees. Wood originating from more than 1-meter away from the stream was likely delivered to stream by windthrow or other processes unrelated to stream bank erosion. More than 83% of the hardwood pieces and 53% of the conifer pieces originated within 10-meters (33-feet) of the stream. More than 70% of all instream debris originated within 20-meters (66-feet), and 85% would come from within 30-meters (98-feet)of the stream. The probability that a tree will fall into a stream decreases with increasing distance from the stream. This data indicates a 100-foot no-treatment buffer on streams would only allow about 15% of the trees that will eventually contribute wood to a stream to benefit from the additional growing space provided by the density management treatment. With a 66-foot no-treatment buffer, only 30% of the trees that will eventually provide wood to the stream would benefit from the increased growing space provided by the thinning.

The distance that a tree is from a stream will also affect the size of the part of the bole where the tree intersects the stream when the tree falls into the stream. The relation of tree dbh to the diameter of the CWD entering the stream, assuming the fallen tree does not slide down the slope[7], is shown in Table ACS-16 below.

[7] While doing their 1992 study on wind damage to stream buffer strips, Andrus and Froehlich also observed that rootwads, even on very steep ground, rarely slid down hill more than 20 feet (McGreer & Andrus 1992).

Table ACS-16: The Bole Diameter in Inches at 16-foot Intervals up the Tree for the Average Tree in Each DBH Class
- Bole diameters below the heavy line are >20-inches.
- Data is based on log taper and board foot tables for Douglas-fir on Coos Bay District-BLM)

DBH	16 ft.	32 ft.	48 ft.	64 ft.	80 ft.	96 ft.	112 ft.	128 ft.	144 ft.	160 ft.	176 ft.	192 ft.	208 ft.
12 in.	10	9	9	6	5								
16 in.	13	12	11	9	8	5							
20 in.	16	15	14	12	11	9	6						
24 in.	19	18	17	15	14	12	10	7					
28 in.	22	21	19	18	16	13	11	7					
32 in.	24	23	22	20	18	16	14	11	8				
36 in.	29	28	27	25	24	23	20	18	15	12	9		
40 in.	32	31	30	28	27	25	23	21	19	16	13	10	
44 in.	33	32	31	29	28	26	25	23	21	19	16	13	10
48 in.	37	36	34	33	31	29	27	25	23	21	18	15	11

In a project where a 66-foot wide no-thin buffer is used between a stream and the thinned area, the thinned trees adjacent to the buffer will need to be about 28-inches in diameter before they can be expected to deliver 20-inch diameter CWD to the stream, based on the information in Table ACS-16 above. In a project where a 98-foot no-thin buffer is used between a stream and the thinned area, the thinned trees adjacent to the buffer will need to be about 36-inches in diameter before they can be expected to deliver 20-inch diameter CWD to the stream.

The following diameter growth data are from stand development simulations used in assessments contained in the Density Management Chapter. They illustrate the time required to grow large diameter trees in thinned and unthinned stands on site II ground:

- Time to obtain 20 and 24-inch average green tree diameters at breast height-
    - Trees in the **thinned** part of the streamside forest will average 20 inches dbh about age 50 to 60-years, and 24 inches dbh about age 70 to 90-years.
    - Trees in an **unthinned** buffer will average 20 inches dbh about age 70-years, and 24 inches about age 120-years on a similar site.
- Time to obtain 20 and 24-inch average diameter dead trees-
    - The **thinned** area will product 20-inch dbh and greater average size dead trees about age 50 to 80 years, and 24-inch dbh size average dead trees by age 70 to 160 years depending on spacing.
    - An **unthinned** buffer will product 20-inch dbh and greater average size dead trees about age 120-years, and 24-inch dbh by 190 years.

Summary of effects of wide no-treatment buffers on attainment of large wood to streams:

- Diameter growth is slower in the unthinned buffer than in the thinned areas delaying attainment of large diameter wood recruited to streams from the unthinned buffers.
- Wide no-treatment buffers reduce the number of trees delivering wood to streams that had benefitted from the growing space provided by the thinning treatment.
- Wide no-thin buffers, delay attainment of large diameter debris produced by the trees in the thinned areas because the desired diameter woody debris has to come from a height on the bole that is directly proportional to the source tree's distance from the stream.

Clearcutting, without retaining a buffer next to streams can raise stream temperature, which stresses fish. However, leaving streamside shrubs and small trees can greatly reduce the stream temperature increases associated with removing all commercial trees next to a stream when compared with temperatures observed following removing all sources of shade from the stream edge by a combination of clearcutting, burning and stream cleaning (Levno and Rothacher 1969 cited in Adam and Ringer 1994). Ten years after clearcutting, vegetation regrowth along Coast Range streams that are less than 10-feet wide will provide shade levels equal to that in mature stands (Summers 1982 cited in Skaugset 1992). Another study showed 50% of a Coast Range stream shaded within 5 years of harvesting and burning (Beschta *et al.* 1987). In contract, a forest canopy is retained following a density management treatment and thus the exposure to sunlight is less than following clearcutting. One near term effect of thinning a stand that is in the stem exclusion stage is to increase the amount of light reaching the forest floor (and potentially streams) from 2 or 3% of full sunlight to light levels that more closely approximate those under a mature stand in the understory reinitiation stage of development. The leave tree crowns will expand to occupy the canopy gaps left by the thinning operation. Following thinning, the period until the canopy gaps are reoccupied by expanding tree crowns above and by an invigorated shrub layer below would be much less than the 10-year recovery time observed following clearcutting next to small streams. The alternative to thinning next to streams, with its short term effects on light levels, is not to thin. Not thinning carries the long term effect of the delay in attainment of large key pieces of durable wood from the untreated areas to the stream. This delay in attainment can be as short as 10 to 20 years if we wait until we have green trees that we can cut or pull over into the stream, or as long as 40 to 70 years if we wait for recruitment of 20-inch diameter key pieces through natural mortality.

<u>Effects of Light-treatment Approaches to Restoring Conifers to Hardwood Dominated Stream Side Stands and Attainment of ACS:</u> Emmingham and coauthors (2000) evaluated 34 riparian restoration projects done by the Forest Service and BLM in the Coast Range. The following is from their discussion section:

> [S]*uccessful restoration of conifers* [to streamside stands] *will require an active approach, including marked reduction of competing shrub and overstory trees, at least in patches. The conservative nature of the silvicultural approaches applied in many projects suggest that some managers ignored the high probability of failure without aggressive and effective control of competing vegetation. Our survey of competing vegetation revealed a basic conflict in carrying out the objective of growing large conifers: one-quarter of the projects were at the same time trying to minimize impact on the existing overstory. In addition, we observed that thinnings or creating gaps were done so conservatively that they failed to provide adequate release of existing conifers. The message is clear: It is a waste of time and resources to attempt restoration of conifers in areas where other resource values will preclude an aggressive approach to establishing conifer dominance. Since conifer restoration can be applied in patches, such conflicts should be easy to avoid.*
>
> *Unfortunately, the growing conditions provided by the conservative treatments applied in many restoration projects will not lead to development of large conifer trees [dbh 60 cm (>2 ft)] in the 21st century. Most of the conifers will not survive the combination of poor growing conditions and animal damage. Active management of both overstory and understory to give conifers plenty of growing space is the only way to promote conifers into a dominant (free-to-grow) position.*

The potential conflict between protecting streams from the near term effect of direct sunlight heating streams and obtaining large trees that can supply large durable wood to the stream is greater for hardwood conversion projects than for density management. This conflict stems from the biological necessity for green plants, like conifers, to receive a threshold level of sunlight just to meet respiration needs for survival, and a need for higher light levels to produce net growth. As noted in the discussion on density management above, the wider the no-treatment buffer between a conversion project and the stream, the longer the time needed before the conifers in the converted area can deliver large diameter wood to the stream. One approach to developing an effective hardwood conversion project includes:

- Use the narrowest streamside buffer consistent with providing shade in the near term and obtaining large wood in the long term.
- Provide sufficient sunlight to the conifers to insure survival and good growth.
- We do not advocate clearcutting to the stream edge. However, research indicates that ten years after clearcutting, vegetation regrowth along Coast Range streams that are less than 10-feet wide will provide shade levels equal to that in mature stands (Summers 1982 cited in Skaugset 1992). This suggests that if a stream side buffer on a small stream turns out to be too narrow to provide maximum protection from solar

heating then the impact will at worst, last 10-years.

<u>The effect of retention of red alder stands and attainment of Riparian Reserve functions:</u>

- Alder and understory shrub roots maintain streambank stability.
- Little or no durable large wood delivered to the stream or to the riparian forest floor. Small and moderated sized nondurable alder wood delivered to the stream and forest floor with the largest pieces provided between stand age 90 to 130 years (Newton & Cole 1994). No wood delivery after the alder stand completely breaks up. A disturbance would be necessary to reestablish trees on the site.
- The alders provide shade until stand senescence. Stand will start breaking up when it is about 100-years old and will be gone about age 130-years. If present, residual conifers may provide partial shade. Salmonberry may provide full shading over narrow streams following stand break-up.
- Riparian microclimate is maintained until stand breakup. Stand breakup will create a hard edge resulting in microclimate edge effects reaching into the adjacent stands. Brush competition will maintain the edge conditions by preventing successful regeneration of a replacement stand.
- Understory shrub herbs and shrubs filter sediment.
- Alder stand provides habitat for species associated with hardwoods and disturbed sites. After stand breakup, site provides habitat for species associated with shrubs.

<u>Conversion of red alder stands to conifer and attainment of Riparian Reserve functions:</u>

- A narrow buffer would retain the alder and understory shrub roots that provide streambank stability.
- Depending on site quality and thinning intensity, delivery of large durable wood from 20-inch diameter conifers to the stream and forest floor begins between stand ages of 50 and 90 years. Some nondurable wood delivered to the stream from the alder buffer strip next to the stream. A pulse of alder wood could be placed in the stream and retained for down wood habitat as part of the project design for the conversion project. Conversion will result in forgoing the pulse of wood to the stream and forest floor associated with alder stand senescence.
- Buffer strip would provide shade. If a buffer strip next to a small stream blows down or is inadequate, then recovery of stream shading would be provided by the young conifers and shrubs in about 10-years. Blow down into and across the stream would provide dead shade. Very small streams can be fully shaded by salmonberry or other shrub species. The conifer stand can shade a stream for several centuries.
- Riparian microclimate would be recovered when the new conifer stand grows tall enough to block gap below the canopy of adjacent older stands. The time to full microclimate recovery is dependent of the height of to base of the adjacent stand’s canopy.
- Buffer strip filters sediment. The recovery of the herb and shrub layer on Coast Range sites following disturbance is rapid. Sediment delivery is a risk only if site is compacted and gullied.
- Stocking control can put the conifer stand on a trajectory to develop into late-successional habitat.

<u>Density Management</u>: Density management is similar to commercial thinning in that a portion of the trees are cut in younger stands. The difference is that commercial thinning is designed to obtain an optimum combination of volume yield and economic value over the life of the stand. Density management treatments are designed to assure and/or speed attainment of habitat attributes associated with late-successional forests and riparian forests. Depending on the site and the project objectives, stands as young as 25-years may be treated. The Forest Plan emphasizes density management treatments in younger stands. An REO review and exemption are required before density management can be applied to stands older than 80-years in the LSR. An REO review is not required before applying density management to stands older than 80-years that are in the Riparian Reserve but outside an LSR. However, younger stands generally have a more rapid growth response and develop desired overstory stand characteristics quicker than older stands following thinning. Also young plantations and aerially seeded units, which were regenerated following clearcutting, tend to have less carry over legacy (large snags, older residual trees, large diameter woody debris) than do older stands of natural origin. Since young stands generally respond more rapidly to density management than older stands,

and since older stands of natural origin often have some late-successional characteristics, as a result of legacy elements, preferential selection of young stands will result in a more rapid attainment of late-successional characteristics across the landscape for a given amount of effort.

Stands receiving density management treatments will provide larger diameter trees and snags to the riparian area, and larger diameter CWD to both the aquatic and riparian systems in a shorter time than will untreated stands, as shown in Table ACS-17.

Table ACS-17: Stand Age When 20 Inch Diameter Live and Dead Trees Are Attained
(From the Density Management and Conversion Treatments and Attaining Riparian Reserve Function section)

	PCTed stand with no subsequent density management treatment	PCTed stand receiving a density management treatment at age 40 leaving 120 trees/ acre	PCTed stand receiving a density management treatment at age 40 leaving 60 trees/ acre
Stand age when the average newly dead tree has a dbh $\geq$20 inches:	120 to 180 years	80 to 90 years	50 to 60 years
Stand age when the average live tree has a dbh $\geq$20 inches:	70 to 110 years	60 to 70 years	50 to 60 years

Shortening the time taken by a stand to produce large diameter wood, which is recruitable to the stream channel and riparian areas, will speed restoration of terrestrial habitat components and provide instream CWD sooner. Earlier recruitment of large instream CWD is needed because large wood can store sediments, and trap gravel deposits. Large CWD can modify the stream hydrology in ways favoring formation of deep pools, backwaters and off-channel habitats. These benefits are accrued both next to the treated stand and downstream. Thinning also increases the light level reaching the forest floor. The increased light allows understory herbs, shrubs and trees to establish and grow, which in turn results in greater live structural diversity. This would benefit many riparian species dependent on multilayered forest habitats over time.

Thinning reduces suppression mortality, which reduces the recruitment rate of small CWD and snags in the short term. Thinning would also allow more light to reach the forest floor. This can be viewed both as a negative effect or a positive effect depending on which habitat attribute is considered. Increased sunlight could cause a short term undesired drying of habitats used by moisture dependent species. However, increased sunlight would also allow for the reestablishment of the herb and shrub layers where they are currently inhibited due to the lack of light penetration. In the near term, forgoing density management favors species and habitats associated with mid seral stand conditions. In the long term, density management favors species and habitats associated with late-successional forest conditions.

Density management affects on temperature and humidity levels last only until canopy closure occurs. Widely spaced thinnings can result in a rapid recruitment of an understory stand, early attainment of complex deeply fissured bark, and development of deep canopies. Wide spacing would also affect the in-stand temperatures and humidity more than a conservative thinning. Thinnings would have little to no effect on the stream flows as the residual trees would use any increased soil moisture that becomes available following harvest.

Short term impacts from density management would be avoided in unthinned riparian areas, and by incorporating no-cut buffers along streams and no thin patches in density management projects. Thinned and unthinned areas would provide a variety of habitat connectivity levels within and between watersheds. Unthinned areas would provide continual input of snags and down wood of a smaller size in the short and long term. Additional benefits from unthinned areas would include shade retention along streams. Shade maintains cool and stable temperatures throughout the year. Stream side vegetation maintains the physical integrity of stream banks.

Recent research is forcing new discussions on what are appropriate stocking levels for areas managed to attain late-successional characteristics. Tappeiner *et al.* (1997) observed that old-growth trees in the Coast Range exhibited a very rapid rate of growth as young trees. Those trees often averaged 20 inch DBH at age 50 and 40 inches at age 100. By running stand development simulations, Tappeiner *et al.* found stocking levels of 31 to 46 trees per acre at age 20-years resulted in the better fit to observations made in old-growth stands with respect to total densities of the larger diameter classes. This suggests that plantations stocked to levels consistent with maximizing volume or economic value on a 40 or 60-year rotation are unlikely to develop characteristics typical for Coast Range old-growth without either active management or a disturbance. Based on Tappeiner's study, our own observations on old-growth diameter growth rates in this Watershed, and on stand modeling, we would need to reduce stocking levels below 80 trees per acre on the first density management entry if we are to redirect the stand development trajectory to become in line with that followed by the old-growth in this Watershed. Fully attaining ACS objectives #2, #8, and #9 may require us to manage some stands for stocking levels below 80-trees per acre.

Based on current knowledge and recent experience, density management prescriptions that include thinned and unthinned patches across the landscape would provide habitat complexity, and allow for retention of those desirable elements currently present on the project site while putting the stand on a path toward late-successional stand development. The levels of both beneficial and detrimental impacts associated with thinning are correlated with the post-treatment stand density, how creative the ID team was at managing for various habitat characteristics, and where they apply a particular treatment in the Watershed. Attaining all the ACS objectives will require following the Best Management Practices and managing for a range of stocking levels across the landscape. This range goes from the low densities consistent with attaining old-growth characteristics to high stocking densities, found in no-cut areas and/or lightly thinned areas, that preserve the high humidity and full shade levels desired for attaining other ACS objectives.

<u>Salvage:</u> Post-catastrophic event salvage is expected to be limited in the Watershed as the weather conditions rarely provide the combination of large rain events and unusually strong wind patterns necessary to create a large blowdown area. Individual tree and small patch blowdown do occur during typical winter storms. Given current access and fire suppression efforts, large fires are rare and small fires are rapidly controlled. The South Coast - Northern Klamath Late-Successional Reserve Assessment (USDI; USDA 1998) contains the recommendations for dealing with salvage in the LSR portion of the Watershed. Salvage may only take place in disturbed sites greater than 10 acres that have a canopy closure less than 40%. All green trees likely to survive, should be retained. Following salvage operations, at least 24 snags per acre of the largest diameter will be retained. Requirements for down wood retention are to be based on plant community, seral stage, site conditions, risk of future disturbances, and other factors (USDI; USDA 1998 pg. 72-73). Coarse woody debris retention guidelines for Coast Range sites are as follows (USDI; USDA 1998, pg.90):

- First site potential tree height – 3,600 - 9,400 cubic feet/ acre
- Second site potential tree height – 1,600 - 2,300 cubic feet/ acre

The data used to develop the recommendations for salvage following a catastrophic disturbance in the LSR is also applicable to the Riparian Reserves that are outside the LSR. Therefore, we recommend following the LSR assessment guidelines for post-catastrophic event salvage should the need arise in the Riparian Reserves outside the LSR.

The Coos Bay District RMP/ROD allows salvage inside the Riparian Reserve only if it is required to attain ACS objectives, and if present and future woody debris needs are met (USDI 1995). The Best Management Practices section provides additional guidance that states "Naturally-occurring down logs or trees will not be removed from the Riparian Reserves except for the benefit of the stream or Riparian Reserve. Potentially floatable debris that may be mobilized during infrequent high floods and may reasonably damage downstream users' improvements may be removed after watershed analysis" (USDI 1995 pg D-2). Given this context, salvage activities may be justified to the extent needed to obtain sufficient planting spaces for rapid reforestation, and to reduce hazards created by catastrophic events that may further threaten the function of the Riparian Reserve. For example following a fire, we may need to use a salvage operation to create a fuel break between remnant green patches of trees and down slope heavy fuel concentrations so to reduce the risk that a reburn might destroy those patches. Salvage logging may be needed to prevent a bark beetle epidemic and allow access to the ground for reforestation following an extensive blowdown event across the landscape. The recommended snag and down wood retention levels are based on observations and measurements made in natural stands. They are designed to provide for large wood structure in the replacing stand while reducing the risk of additional green tree and structural losses due to reburns and insects. The recommended snag and down wood retention levels still represent a sizable fuel load. Consequently for salvage to be effective at protecting the function of the Riparian Reserve, the treatment should be designed to break up fuel continuity and not just reduce the volume of fuel on the site. The retention levels would also result in increases in bark beetle populations on shady sites but not on sunny sites (Smyth 1959). Post catastrophic event salvaging will not necessarily prevent the loss of additional green trees to bark beetles, but would reduce the numbers of green trees lost compared with the no treatment alternative[8]. Retention of fire charred trees, and some charred snags and down wood would benefit those wildlife species[9] that consume insects that specialize in colonizing fire injured or killed trees (Murphy; Lehnhaysen 1998).

Past salvage operations outside the road prisms but inside what is now the Riparian Reserve have resulted in the loss of certain habitat components associated with several ACS objectives. Those ACS objectives for structural diversity, habitat complexity, nutrient cycling, large wood recruitment and subsequent instream and riparian habitat development are the most affected. To prevent the further loss of these components, salvage outside road prisms is not recommended except in those cases where reduction of the size large accumulations of wood is necessary to protect the Riparian Reserve from greater injury by fire, insects or other damaging agents.

Hazard tree removal along BLM roads, which is different from road side salvage, occurs infrequently and is necessary to provide safe driving conditions for the public. The ROD/RMP allows for the removal of these hazard trees (USDI 1995: pg.70). The ROD/RMP also recommends leaving trees on the site when CWD amounts are inadequate or the topping of trees as an alternative. In Riparian Reserves, retention would help to attain ACS objectives over the long term.

[8] The Vegetation and Disturbance Processes Appendix includes an the epidemiology of the Douglas-fir bark beetle.

[9] The black backs characteristic of many woodpecker species may be an adaptation that allows those species to be less conspicuous when they are foraging on the charred surfaces of burned trees, snags and down wood.

Figure 2: Excavator pulling the fill from a stream crossing and recontouring the slope during the decommissioning of a road. Photograph by Dan VanSlyke, July 2001, on the 28-11-19.02/-19.03 decommissioning project in Wimer Creek.

Figure 1: This is the site where the 28-11-19.02 first crossed Wimer Creek immediately after road decommissioning in July 2001. At this site, the culvert and road fill were removed, stream gradient restored, and stream-side slopes restored. The road bed and site of the fill were seeded and mulched. Photograph by Dan VanSlyke.

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